

SOILS

A Publication of the Soil and
Water Management &
Crop Nutrition Sub-Programme
of the Joint FAO/IAEA Division
of Nuclear Techniques in Food and
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A. TO OUR READERS

The sub-programme is implementing a range of new activities in 2002 including research projects, an international symposium, enhanced interagency collaboration and publication of research results and guidelines on the use of nuclear techniques in integrated soil, water and nutrient management. The FAO/IAEA Joint Division homepage has been redesigned to give both the flavour and feel of the IAEA and FAO homepages, and information on the website on sub-programme projects, meetings and publications will be regularly up-dated.

Two new co-ordinated research projects (CRPs), each of 5 years duration, were approved in March.

- “Assess the effectiveness of soil conservation techniques for sustainable watershed management using fallout radionuclides”
- “Selection for greater agronomic water use efficiency in wheat and rice using carbon isotope discrimination”

Both CRPs are interdisciplinary - the first with the Isotope Hydrology Section and the second with the Plant Breeding and Genetics Section. Research contract and agreement proposals are presently being invited for the first project, which will be implemented in 2002, while the second project will be implemented in 2003.

Preparations for Symposium 59 “*Towards Integrated Soil, Water and Nutrient Management in Cropping Systems: the Role of Nuclear Techniques*” at the 17th World Congress of Soil Science, 14 – 21 August 2002, Bangkok, Thailand, are being finalized. Due to the large response to the call for papers, the symposium was extended from a half-day to a full-day event, with 14 oral presentations and approximately 80 poster presentations scheduled. As sponsors of Symposium 59, we have been offered a cost-free booth to display our projects and products. The symposium and booth are both important mechanisms to increase awareness and visibility and demonstrate sub-programme activities to a large cross section of the international scientific community concerned with natural resource management. The Agency is providing financial support to nine participants from developing countries to attend the Congress.

Memoranda of Understanding (MOUs) were signed recently with several Organisations to foster international co-operation and collaboration. The agreements are with the International Fertilizer Development Centre (IFDC), the Tropical Soil Biology and Fertility Programme (TSBF) and the International Wheat and Maize Improvement Centre (CIMMYT). MOUs were previously agreed with IRRI, ICRAF, ICRISAT, ICARDA, IITA and CIAT both before and after the review of the sub-programme in 1996, which recommended expanded partnerships and full participation in Consortia on Soil, Water and Nutrient Management. In line with this latter recommendation, the sub-programme became a partner in the Rice-Wheat Consortium (RWC) for the Indo-Gangetic Plains (IGP) early in 2002 following implementation of a new CRP in the last quarter of 2001. CRP participants include the NARS partners of the RWC from Pakistan, India, Nepal and Bangladesh, the IRRI Rice-Wheat Co-ordinator and the CIMMYT Rice-Wheat Facilitator for the RWC-IGP, as well as two contract holders from China and an Agreement Holder from Australia.

The 1996 review of the sub-programme also recommended closer linkages with sister Divisions in FAO, principally the Land and Water Development Division (AGL), but also the Plant Production and Protection Division (AGP). Apart from regular participation of FAO technical experts at Research Co-ordination Meetings, the sub-programme has co-initiated and co-ordinated several joint efforts.

- Consultants Meeting on “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia” (with AGP, 23 – 25 August 2000, Rome).
- Technical Expert Meeting on “Increasing the Use of Biological Nitrogen Fixation (BNF) in Agriculture” (with AGL, 13 – 15 March 2001, Rome).
- Sharing of AGE display booth with AGL at the 17th World Congress of Soil Science (14 – 21 August 2002, Bangkok).
- FAO/IAEA publication (FAO Water Report No. 22) on “Deficit Irrigation Practices” (in press).
- FAO/IAEA publication (FAO Land and Water Bulletin) on “Use of Local Phosphate Rocks in Sustainable Agriculture” (in preparation).
- FAO/IAEA Publication (FAO Irrigation and Drainage Paper) on “Crop water use productivity” (planning meeting 28 February – 1 March 2002, Rome).

In addition to the abovementioned bulletins, several important titles are due for publication in 2002. Demand for synthesised information from Member States on the theory and applications of nuclear-based techniques will be addressed through publication and dissemination of training manuals, books, conference proceedings and special issues of international journals.

- “Neutron and Gamma Probes: Their Use in Agronomy”. IAEA Training Course Series. (in press, En, Fr, Sp).
- “Utilization of phosphate rocks to improve soil P status for sustainable crop production in acid soils”. Special issue of the journal *Nutrient Cycling in Agroecosystems*. Kluwer Academic Publishers. (in press).
- “Irradiated Sewage Sludge for Application to Cropland”. IAEA TECDOC. (in preparation).
- “Assessment of Soil Erosion and Sedimentation using Environmental Radionuclides. Handbook”. Kluwer Academic Publishers. (in preparation).
- “Field application of the ¹³⁷Cs technique in soil erosion and sedimentation studies”. Special issue of the journal *Soil and Tillage Research*. Elsevier. (in preparation).
- “The Use of Isotopes of Sulfur in Soil/Plant Studies”. IAEA Training Course Series. (in preparation).
- “Maximising the Use of Biological Nitrogen Fixation in Agriculture”. G. Hardarson and W.J. Broughton, eds. Kluwer Academic Publishers. (in preparation).

The Soil Science Unit, Seibersdorf, is conducting the 6th interregional proficiency testing exercise “EQA2002” on total N and ¹⁵N analyses of plant materials. Last year very good results were obtained from 10 institutes in all regions and satisfactory results were received from a further 4 institutes. Institutes with either optical emission or mass spectrometers are encouraged to participate in this activity to check on performance and institute remedial measures if necessary.

With my very best wishes,

Phillip Chalk
Head, Soil and Water Management
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3. Staff Changes

Ms. Lucia Kruzic, Secretary, left the Section on 1st February to take up the post of Senior Secretary, Agriculture and Biotechnology Laboratory, Seibersdorf. We congratulate Lucia on her promotion to this position, and thank her for her dedicated service in the Section's Office.

Mr. Iban Mateos-Peña joined the Section as a temporary Secretary on April 25 following the transfer of Ms. Kruzic to the Agriculture and Biotechnology Laboratory, Seibersdorf. He previously worked in the Technical Co-operation Department, is an accomplished linguist (fluency in English, French, Spanish) and is skilled in computer applications.

Ms. Rebecca Hood-Nowotny, Soil Science Unit, Seibersdorf, has taken maternity leave from February to December 2002. We congratulate her and her husband on the birth of a son, Jan Noah.

Dr. Manbir Sachdev, Nuclear Research Laboratory, Indian Agricultural Research Institute, New Delhi, joined the Soil Science Unit, Seibersdorf, on March 4 for a period of 6 months while Ms. Hood-Nowotny is on leave. Dr. Sachdev has had a long association with the Agency, undertaking expert missions, participating in and conducting fellowship training and participating in the IAEA research contracts programme through several co-ordinated research projects. His work with stable and radioisotopes has contributed significantly to our understanding of the dynamics of plant nutrients and water in legume-cereal-oilseed cropping systems, particularly the macronutrients N, P, K and S and their interactions and the micronutrient Zn, which has led to the development of improved management practices for external inputs of water and fertilizers.

C. FUTURE EVENTS

RESEARCH CO-ORDINATION MEETINGS (RCMs) OF FAO/IAEA CO-ORDINATED RESEARCH PROJECTS (CRPs)

- ⇒ **Third RCM of CRP on “The Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems” (D1.20.07), 2 – 6 June 2003, Colombo, Sri Lanka**

Nine contract holders and five agreement holders are expected to participate. Dr. Sarath Nissanka, Faculty of Agriculture, University of Peradeniya, Sri Lanka, is the local organiser. The participants will present the major results and conclusions of their research covering the period from 1999-2003. All participants will be informed in due course with regard to the details of submission and presentation of progress reports at the meeting. The presented data will be fully discussed and the plan for future work will be updated in line with the project objectives. Gamini Keerthisinghe is the Project Officer and will be the Scientific Secretary.

CO-OPERATION MEETING

- ⇒ **Symposium 59, 17th World Congress of Soil Science, 14 – 21 August 2002, Bangkok, Thailand**

The Joint Division is co-operating with the Congress in organising and sponsoring a 1-day symposium “Towards Integrated Soil, Water and Nutrient Management in Cropping Systems: the Role of Nuclear Techniques”. There will be 14 oral presentations and approximately 80 poster presentations. Mr. Phillip Chalk, is the Symposium convenor. More information on the Congress can be obtained at <http://www.17wcss.ku.ac.th>

FAO CO-SPONSORED MEETINGS

- ⇒ **2nd International Conference on Sustainable Agriculture for Food, Energy and Industry, 8 – 13 September 2002, Beijing, China**

The conference is being hosted by the Institute of Botany, Chinese Academy of Sciences, and co-sponsored by FAO, together with the International Council of the Society for Sustainable Agriculture and Resource Management. The main themes are: 1. Basic elements and strategies towards sustainability. 2. Genetic resources. 3. Renewable energy. 4. Management of resources. Topics to be covered under Theme 4 include (i) Management of soil, water, nutrients and wastes. (ii) Biological, ecological and organic farming. (iii) Restoration of contaminated and degraded land. (iv) Management of marginal land and fragile niches. More information can be obtained at ISAConfe@hotmail.com or lidj@ns.ibcas.ac.cn

⇒ **International Workshop on Conservation Agriculture for Sustainable Wheat Production in Rotation with Cotton in Limited Water Resource Areas, 13 – 18 October 2002, Tashkent, Uzbekistan**

The workshop will be held at the Tashkent Institute of Irrigation and Agricultural Mechanisation Engineers (TIAME). It is being jointly organised with FAO and IWMI. Several Divisions of FAO are involved (AGE, AGLL, AGSE, AGPC). The workshop is expected to attract practitioners, authorities and leading scientists on conservation agriculture, soil management, agronomy, crop protection and global environmental issues. Lee Heng, SSU Seibersdorf, will make a presentation on "Improved Water and Nitrogen Use Efficiency of Cotton and Wheat in Arid and Semi-arid Areas". Lee is presently backstopping a TCP based at TIAME (UZB/5/002) "Optimisation of water and fertilizer use for major crops".

⇒ **2003 IFA Agriculture Conference, 26 – 28 March 2003, FAO Rome, Italy**

The International Fertilizer Association (IFA) is organising its 2003 Conference jointly with FAO. It will address the role of fertilizers in sustainable food security with inputs from key stakeholders in plant nutrition, food production, farm management systems and emerging technologies. Gamini Keerthisinghe will make a presentation on "Plant uptake: Current scientific knowledge and technological trends".

NON-FAO/IAEA MEETINGS

⇒ **International Workshop on "Biological Nitrogen Fixation for Increased Crop Productivity, Enhanced Human Health and Sustained Soil Fertility", 10 – 14 June, Montpellier, France**

The objective of the workshop, which will be held at ENSAM-INRA, is to discuss and define research priorities and strategies for the development of a project proposal for submission to the Scientific Council of the CGIAR for consideration for inclusion in the CGIAR Challenge Programme. Mr. Gudni Hardarson, SSU Seibersdorf, will participate in the workshop.

⇒ **9th International Symposium on Nitrogen Fixation with Non-Legumes, 1 – 5 September 2002, Leuven, Belgium**

The Centre of Microbial and Plant Genetics, Katholieke Universiteit Leuven will host this symposium, which is held every two years. More information can be obtained at the website www.cmpg.be

⇒ **XXXII Annual Meeting of the European Society for New Methods in Agricultural Research (ESNA), 10 – 14 September 2002, Warsaw, Poland**

The meeting will be held at the Faculty of Veterinary Medicine, Warsaw Agricultural University. It will be organised around the 6 working groups of ESNA: 1. Food preservation and safety. 2. Advanced methods in animal sciences. 3. Soil-plant relationships. 4. Plant genetics, breeding and physiology. 5. Quality of agroecosystem. 6. Pest management. The meeting will be held in conjunction with the working group on Soil-to-Plant Transfer of the International Union of Radioecology (IUR). Further information can be found at [Http://www.mendelu.cz/esna/](http://www.mendelu.cz/esna/)

⇒ **International Colloquium: Land Use Management, Erosion and Carbon Sequestration, 24 – 28 September 2002, Montpellier, France**

Participants may select either one or both scheduled symposia.

- The biological approach to soil and water conservation.
- Soil erosion and carbon sequestration.

For more information please contact Dr. Eric Roose, e-mail: roose@mpl.ird.fr

⇒ **4th Austrian Workshop on Stable Isotopes in Environmental and Earth Sciences, 22 – 23 November 2002, Graz, Austria**

The Institute of Geology and Paleontology, Karl-Franzens University, Graz, and the Institute of Hydrogeology and Geothermics, Joanneum Research, Graz, will co-host the workshop. The aim of the workshop is to bring together researchers working with stable isotopes of the lighter elements (H, C, N, O, S) and to encourage dialogue across disciplines and institutions with respect to practical, theoretical and methodological issues. For further information please contact ana-voica.bojar@kfunigraz.ac.at

TECHNICAL CO-OPERATION PROJECTS (TCPs)

⇒ **FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039)**

The overall objective of this project is to develop improved soil, water, nutrient and crop management practices while counteracting predominant soil degradation processes in order to increase and sustain crop productivity. Two complementary approaches will be utilized to achieve this main objective. Part 1 of this project deals with the restoration of soil fertility, and implementation commenced during the 2001-2002 cycle (refer to past events). The specific objective of Part 2 of this project will be to measure soil erosion/ sedimentation and associated pesticide contamination. For this purpose, the fallout radionuclide ¹³⁷Cs and related techniques will be utilized to measure erosion/sedimentation rates and to define soil redistribution patterns in the landscape. Also, radiotracer and conventional techniques will be applied to determine pesticide contamination levels in soil, water and crops. This part of the project commences in 2002 and will be implemented through 2004.

- **Regional Training Workshop on “Use of ¹³⁷Cs Techniques for Establishing Soil Redistribution and its Relationship to Soil Quality Parameters”, 3 – 9 June 2002, Yan’an and Beijing, China**

The training workshop, which belongs to Part 2 of the project, will be organized by the Institute for Application of Atomic Energy, Chinese Academy of Agricultural Sciences (IAAE, CAAS) at two locations: Yan’an and Beijing. The local director of the workshop is Dr. Yong Li and the Technical Officer for the Project is Mr. Felipe Zapata. Prof. R. Loughran, Australia, will be an invited lecturer. It is anticipated that representatives from eight countries in the project (China, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, and Viet Nam) will attend this training workshop. The main purpose of this activity will be to provide training on all aspects of the application of the ¹³⁷Cs technique to the local staff directly involved in the implementation of Part 2 of the project.

- **Mid-Term Review Meeting, 11 – 15 November 2002, Bangkok, Thailand**

This meeting which belongs to Part 1 of the project, will be held at the Department of Applied Radiation and Isotopes, Faculty of Science, Kasetsart University, Bangkok, Thailand. The local organizers are Asst. Profs. Patana Anurakpongsatorn and Pannee Pakkong. It is anticipated that counterparts from Bangladesh, China, India, Indonesia, Malaysia, Myanmar, Mongolia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam will attend this meeting. The main purpose of this meeting will be to review the progress made so far in the project and to discuss future activities. All counterparts will be presenting their major achievements and these will be critically evaluated in line with the specific objectives. The Technical Officer for the Project is Mr. Gamini Keerthisinghe.

⇒ **FAO/IAEA TCP on “Irradiated Sewage Sludge for Increased Crop Production” (EGY/8/014)**

The objectives of this interdisciplinary project are to help national counterparts to undertake on-farm demonstrations of the value of irradiated sewage sludge and wastewater applications for increased crop production, and to conduct a feasibility study for an industrial-scale irradiation plant for waste treatment. The Project is in the final stages of implementation. Mr. O. Gueven (NAPC) and Mr. P. Chalk (NAFA) are the Technical Officers.

- **National Workshop on “Irradiation of Sewage Sludge and Wastewater and Their Use in Agriculture”, 2 – 6 November 2002, Cairo, Egypt**

This workshop will bring together and highlight national efforts to utilize municipal wastes, principally sewage sludges and wastewaters. Participants will be drawn from a wide cross-section of stakeholders, including administrators, agricultural and environmental scientists, radiation and civil engineers, public health officials, decision makers and farmers. The counterpart will make a detailed presentation of the achievements of TCPs EGY/8/013 and EGY/8/014.

⇒ **FAO/IAEA Regional TCP for Europe on “Fertigation for Improved Crop Production and Environmental Protection” (RER/5/011)**

The objective of this project is to increase water and N fertilizer use efficiencies in crops by delivery of external inputs through drip irrigation (fertigation). Nuclear techniques (soil moisture neutron probe and ¹⁵N-labelled fertilizers) are being used to monitor water and nitrogen balances. Eight countries are participating in the project: Bulgaria, Cyprus, FYR Macedonia, Greece, Hungary, Slovenia, Turkey and Yugoslavia. Ms. Lee Heng is the Technical Officer.

- **Annual Co-ordination Meeting, 28 October – 2 November 2002, Kalamata, Greece**

Progress towards achieving the project objectives will be reviewed and analysed and future experimental plans elaborated. Mr. Ioannis Massas, Ministry of Development, General Secretariat for Research and Technology, Demokritos National Centre for Scientific Research, Greece, is the local organizer.

⇒ **Interregional Model Project on “Sustainable Utilization of Saline Groundwater and Wastelands for Plant Production” (INT/5/144)**

This interdisciplinary project, which began in 1997, is in the final stage of implementation. The project objectives were 1. Introduction of known halophytes on 10 ha demonstration sites irrigated with saline groundwater with screening based on survival and economic considerations. 2. Management of irrigation through the use of nuclear and other techniques to avoid surface accumulation of salt. 3. Monitoring of groundwater dynamics through chemical and isotopic analysis to estimate the quality (and possibly quantity) of recharge. 4. Transfer of the technology to the end-users for economic benefit.

- **In-Country Workshops (July 2002, Jordan; September 2002, Tunisia and Morocco)**

These 1 – 2 day events involve all members of the national team assigned to the project travelling together to the demonstration sites where discussions are held and guidance provided by IAEA experts. The workshops are valuable for internal co-ordination and appreciation of objectives and benefits to the end users.

- **Training Course in Germplasms and Genebank, 5 – 9 October 2002, Dubai, United Arab Emirates**

This course is being jointly organised by the Agency and the International Centre for Biosaline Agriculture (ICBA). A Memorandum of Understanding has been signed between IAEA and ICBA. Four participants from IAEA Member States (Jordan, Iran, Pakistan) are expected to enrol for the course.

- **Project Co-ordination Meeting, 12 – 16 October 2002, Dubai, United Arab Emirates**

The final meeting of national co-ordinators will be held at the International Centre for Biosaline Agriculture (ICBA).

⇒ **FAO/IAEA Regional TCP for Africa “ Combating Desertification in the Sahel” (RAF/5/048)**

The overall objective is to sustainably intensify food production in the rainfed agriculture of Sahelian countries, in order to enhance food security while combating desertification. The specific objective is to develop, pilot-test and promote the adoption of improved and integrated soil, water and nutrient management technologies in cropping systems through the use of nuclear and related techniques. The short-term goal is to improve the productivity of the system, while the long-term goal is to restore and maintain the soil fertility to effectively combat dry-land degradation. The target area is the West African Sahel and includes Burkina Faso, Mali, Niger and Senegal.

The first project co-ordination meeting was held in Ouagadougou, Burkina Faso from 18 – 21 February 2001. During the initial phase (first two years) of the project activities will be implemented to strengthen the national capacities and to establish a network of field trials to generate specific technologies for improved and integrated crop, soil, water and nutrient management in millet-based cropping systems.

- **Second Co-ordination Meeting, February 2003, Niamey, Niger.**

The project co-ordinators of the participating countries (Burkina Faso, Mali, Niger and Senegal) will attend the meeting. The main objectives of this meeting are: a) to assess the progress made in implementing the project during the first biennium, b) to elaborate a new Action Plan of the project for the next biennium, and c) to prepare the report of the meeting. Mr. F. Zapata is the Technical Officer and organizer of the meeting.

D. PAST EVENTS

RESEARCH CO-ORDINATION MEETINGS (RCMs) OF FAO/IAEA CO-ORDINATED RESEARCH PROJECTS (CRPs)

⇒ **First RCM and Training Workshop of CRP on “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia”, 4 – 8 March 2002, Vienna and Seibersdorf, Austria**

Five research contract holders from Bangladesh, China (2), India and Nepal, three agreement holders from Australia, India and the Philippines and a representative from FAO, Rome, Mr. E. Guimarães (AGPC), attended the meeting. Presentations were made during the first 3 days on on-going work in Rice-Wheat cropping systems in China and the Indo-Gangetic Plain, with reference to activities co-ordinated under the aegis of the Rice-Wheat Consortium and other bilateral agreements. Research objectives, approaches and protocols were discussed and agreed upon. The Project Officer, Mr. P.M. Chalk, served as the Scientific Secretary. The last two days involved a training workshop at the Soil Science Unit, Seibersdorf, on measurement of soil water status and water balance and the use of ¹⁵N labelling techniques to follow the movement and fate of soil, fertilizer and crop residue N in

the multiple cropping system. A Report of the Meeting has been prepared by the Scientific Secretary and distributed to participants.

⇒ **Second RCM of CRP on Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils Through the Use of Nuclear and Related Techniques”, 11 – 15 March 2002, Brasilia, Brazil**

This second RCM was held in Brasilia at the Headquarters of the Brazilian Agricultural Research Corporation (EMBRAPA). Six contract holders, four agreement holders and one technical contractor participated in this RCM. The local organizer was Dr. Segundo Urquiaga, EMBRAPA-Agrobiologia, Seropédica, Rio de Janeiro, Brazil. The Project Officer, Felipe Zapata, served as Scientific Secretary and Ms. Lee Heng, Soil Science Unit, Seibersdorf Laboratories, as a resource person for the use and application of models. Two and a half days consisted of technical sessions, with presentations by the participants. One full day was devoted to a field excursion to the “Cerrado” region and the last one and a half days to group discussion sessions on the experimental protocols and a final session on future activities and conclusions and recommendations.

The participants presented their research progress reports highlighting the main areas of investigation, i.e. identification of adapted genotypes, correction of acidity and infertility and development of improved soil management practices. The results obtained so far were thoroughly discussed. In accordance with the objectives of the meeting, overall progress in implementation of the project was assessed. It was noted that research work in its initial phase focused on the identification of the cereal crop (maize and sorghum) genotypes best adapted to acid soil (Al toxicity and low P) conditions, and legumes species and cultivars (grain legumes such as soybean, cowpea, common bean and peanut and green manures/cover crops) for enhanced nitrogen fixation in acid soils. Also, field studies on individual components of crop rotations have been conducted.

A field excursion was organized to Embrapa-Cerrados in Planaltina DF to visit experiments on development of improved pastures systems for the renewal of degraded grazing lands. Several grazing-pasture technologies and integration of cropping and grazing systems were observed. Also, long term experiments on the development of sustainable agricultural production (crop rotations and agroforestry systems) compatible with the Cerrado ecosystem were observed. Thereafter, a visit was made to a large (some 2,300 ha) private farm (Fazenda Sementes Primavera), where Prof. Dr. W. Goedert explained the technologies used and problems encountered in large-scale production of cereals under zero tillage. The field visit provided an insight on the main technical and socio-economic constraints for the sustainable development of the savannas of Brazil (the Cerrados region), and the approaches/strategies followed to overcome them at both research and large-scale farm levels. Discussions centered on the key role of organic matter on soil properties and the productivity and sustainability of the production systems, and how to maintain and increase both the content and quality of soil organic matter.

Ms. Lee Heng, delivered a lecture on the role of models, in particular the use of APSIM and DSSAT models in rainfed agriculture. This was followed by a discussion to define specific modelling topics and data input requirements. Selected publications and references were distributed to the participants. Dr. Robert M. Boddey, Embrapa-Agrobiologia, delivered a lecture on the improvement of pasture production and the stocks of soil organic C and N by

the introduction of forage legumes into *Brachiaria* pastures. Carbon and nitrogen stable isotopes were utilized to quantify biological nitrogen fixation in the legume and to examine the accumulation of soil C derived from the C4 *Brachiaria* residues against a background of C3 residues from the original native vegetation and the legume.

The need for an integrated approach to soil, water and nutrient management (SWNM) at the level of the cropping system was discussed and agreed to. Following the presentations of the participants, general discussions were held on the future implementation of the project. Participants were asked to define their research plans in terms of type of studies and cropping systems. The research protocols were revised and modified accordingly by the participants. At the end of the meeting, the participants formulated a series of conclusions and recommendations for further implementation of the project. The report of the RCM is available from the Scientific Secretary upon request.

TECHNICAL CO-OPERATION PROJECTS (TCPs)

⇒ FAO/IAEA Regional TCP for Africa on “Biofertilizers to Increase Smallholder Crop Production” (RAF/5/045)

- **Annual Review Meeting, 10 – 15 December 2001, Dakar, Senegal**

Project counterparts from Kenya, Senegal, Sudan, Tanzania, Uganda, Zambia and Zimbabwe attended the meeting, which was conducted by the Technical Officer, Mr. M.P. Salema. Each country gave a report of the work carried out and the results obtained in 2001. It was concluded that satisfactory progress was made in implementing the project in all countries, and collaboration was fostered through exchange of cultures, seeds and literature and ¹⁵N analysis of plant samples.

⇒ FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039)

- **Project Formulation Meeting “Measuring Soil Erosion/Sedimentation and Associated Pesticide Contamination”, 26 February – 1 March 2002, Beijing, China**

Twelve representatives from Australia, China, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam attended the meeting. IAEA was represented by Mr. Felipe Zapata, Technical Officer, and Mr. Kyoung-Pyo Kim, Project Officer.

The objectives of the meeting (Part 2 of the project) were:

1. Review and evaluate information on recent developments/application of the ¹³⁷Cs technique and provide guidelines on its application
2. Assess the expertise and resources required for field and laboratory work in each country and identify/select suitable study areas (catchments)

3. Establish a national project committee and identify mechanisms of transfer of results
4. Establish a work plan of the project and elaborate detailed project activities

The presentations of the country reports and discussions highlighted the urgent need to identify suitable land use and soil management practices to control soil erosion and sustain crop productivity in the Asia and Pacific region. An assessment of the national capacities (trained human resources and adequate analytical facilities) and future needs to implement the project, in particular for the application of the ^{137}Cs technique in soil erosion and sedimentation studies, was made. Of the eight developing countries participating in the meeting, three have very satisfactory conditions for implementing the project because of past IAEA TC assistance, while four others met the minimum conditions but need further support to upgrade facilities and/or strengthen their capacities. One country did not have relevant staff for the application of the ^{137}Cs technique. The main types of studies and scale of the work to be conducted in the frame of the project were discussed. Also, guidelines to be followed in the implementation of such studies were prepared. Prof. Robert Loughran, Australia, presented guidelines for the standardized application of the ^{137}Cs technique in soil redistribution studies, and Prof. Xu Bujin, CPR, those for agrochemicals (pesticides) studies.

Draft country work plans were prepared by the participants. National counterparts were requested to submit to the IAEA their final revised work plans before the end of March 2002, including specific details of expert missions, fellowships, minor equipment, and other requirements needed for implementation of the project. A regional project work plan and logical framework matrix were also prepared. China was identified as the focal Regional Resource Unit (RRU) for training and analytical services in the ^{137}Cs technique for soil erosion studies. Viet Nam was proposed as the RRU for analytical and external quality assurance services for ^{137}Cs measurements and Australia for providing training and expert assistance in the application of the ^{137}Cs technique in soil erosion and sedimentation studies. Participants formulated a series of conclusions and recommendations for implementing the project, in particular the regional events. A report of the PFM is available from the Technical Officer upon request.

⇒ **Interregional Model Project on “Sustainable Utilization of Saline Groundwater and Wastelands for Plant Production” (INT/5/144)**

- **Project Co-ordination Meeting, 20 – 24 January 2002, Amman, Jordan**

The objectives of the meeting were to review the implementation of the project, the results already achieved and the project accomplishments. Outputs from the meeting included an approved work plan for 2002 and a set of recommendations to ensure successful completion of the project in 2002. National co-ordinators from Egypt, Jordan, Iran, Tunisia, Syria, Morocco, Pakistan, Algeria and United Arab Emirates attended the meeting. Four IAEA experts (Dr. Edmundo Garcia Agudo, Brazil; Dr. Cevat Kirda, Turkey; Dr. Muhammad Sajjad, Pakistan; Dr. Mujtaba Naqvi, Pakistan) also participated.

- **Group Training, 8 – 19 April, Faisalabad, Pakistan**

A hands-on training workshop for farmers and other field workers was held at the Nuclear Institute of Agriculture and Biology. Dr. Mazhar Naqvi was the local organizer.

Participants from 6 countries were trained in cultural practices for growing salt-tolerant plants that are being disseminated to farmers for vegetation of saline wastelands using saline groundwater for irrigation.

- **Training Course on Halophyte Production and Management, 27 April – 2 May 2002, Dubai, United Arab Emirates**

This course was jointly organised by the Agency and the International Centre for Biosaline Agriculture (ICBA). Seven participants from IAEA Member States (Jordan, Egypt, Morocco, Tunisia, Syria, Iran) enrolled for the course.

- **In-Country Workshops (March 2002, United Arab Emirates; April 2002, Syria; May 2002, Egypt; June 2002, Algeria and Iran)**

Nationally funded one- to two-day visits to demonstration sites of all national personnel assigned to the Project for on-site discussions, assisted by IAEA experts.

⇒ **FAO/IAEA TCP on “Soil Fertility Improvement and Water Management” (MAK/5/003)**

The objectives of the project, which began in 1999, were to increase the capacity of the Faculty of Agriculture, University of Ss Cyril and Methodius, Skopje, for assessing soil water balance and fertilizer recovery using nuclear and related techniques, and to monitor nitrate leaching to groundwater in order to improve fertilizer recovery and irrigation management. The specific objectives were to develop staff expertise through fellowship training and expert missions and to build infrastructure through the supply of equipment.

- **Project Review and Opening of Laboratory, 25 – 26 April 2002, Skopje, FYR Macedonia**

The Technical Officer, Ms. Lee Heng, reviewed progress towards the project objectives including all technical aspects of the work, results achieved and constraints to implementation. The work plan was revised and further elaborated. During the course of the project 3 fellows were trained and 3 expert missions were fielded. A significant achievement was the refurbishment and equipping of a soil water laboratory through Agency support. Ms. Heng attended the official opening of the laboratory with the counterpart, Prof. d-r Ordan Cukaliev, Vice-Dean for International Co-operation in the Faculty.

⇒ **FAO/IAEA Regional TCP for Africa on “Combating Desertification in the Sahel” (RAF/5/048)**

- **Technical Meeting and Training Workshop on “Use of Nuclear Techniques in Soil, Water and Nutrient Management in Rainfed Arid and Semi-arid Areas”, 18 – 22 March 2002, Vienna and Seibersdorf, Austria**

This technical meeting was organized for the national co-ordinators of Burkina Faso, Mali, Niger and Senegal currently participating in the regional project. Dr. Andre Bationo,

Tropical Soil Biology and Fertility Programme, Nairobi, Kenya, also attended the meeting as a consultant and was elected as “rapporteur” of the meeting. Mr. F. Zapata, Technical Officer, and Mr. P. Bhakta, Project Officer, conducted the meeting. The main objectives of the meeting were: i) To get acquainted with recent developments on the use of nuclear techniques for integrated soil, water and nutrient management, with emphasis in rainfed cropping systems in arid and semi-arid areas, ii) To establish contacts with relevant staff of the Department of Technical Co-operation and become familiar with administrative procedures for implementing the project, iii) To review and prioritize the experimental plans of each country participating in the project, iv) To promote the establishment of a national project committee comprising a team of experienced scientists and stakeholders, including agricultural extension services and co-ordination with other initiatives on desertification at the national and regional level, and v) To identify mechanisms for transferring promising technologies emanating from the project to end users.

Mr. P.M. Chalk presented an overview of the activities of the sub-programme including operational CRPs and TCPs. The essential criteria for an IAEA technical co-operation project were explained by Mr. P. Bhakta of the Africa Section, TC Department. Participants presented their progress reports on the implementation of the project and Dr. Andre Bationo delivered a lecture on soil degradation problems in arid and semi-arid areas and the available technologies for combating desertification. He also presented the activities of the TSBF programme, with emphasis on the “African Network for Soil Biology and Fertility” (AFNET).

Three days were devoted to a training workshop at the Soil Science Unit, Seibersdorf, on the use of nuclear techniques for developing improved agronomic, soil, water and nutrient management practices in cropping systems. Staff of the Section and Unit were involved in the lectures and practical sessions. The work plan of each country was revised and the IAEA inputs in terms of experts, equipment and fellowship training were defined. At the end of the meeting the participants formulated conclusions and recommendations for further implementation of the project. The report of the meeting is available from the Technical Officer upon request.

- **Regional Training Course on “The Use of Nuclear Techniques in Nitrogen and Water Dynamics in Rainfed Arid and Semi-arid Areas” 8 – 12 April 2002, Dakar, Senegal**

The training course was held at the Senegalese Institute of Agricultural Research (ISRA) in Dakar and Bambey. Dr. M. Khouma was the local Course Director. Invited lecturers were F. Ganry and P. Moutonnet, France. Local lecturers were Mamadou Khouma, Ibrahima Ndoeye, Mamadou Gueye, Diaga Diouf, Fatou Gueye, and Modou Sene. Twenty- one participants from the counterpart institutions in Burkina Faso, Mali, Niger and Senegal attended the course. Topics included: Basic concepts of nuclear physics; use of ^{15}N to measure utilization in fertilizer studies and N supply from organic materials; biological nitrogen fixation (BNF) studies; use of ^{15}N to measure nitrogen fixation in legumes; enhancing BNF in grain legumes; trees in agroforestry and agro-silvopastoral systems; sample preparation and analysis of ^{15}N with the NOI-7 optical emission spectrometer; soil moisture measurement (neutron probe and other techniques) and field water balance.

⇒ **FAO/IAEA Regional TCP for East Asia and the Pacific (RCA) on “Restoration of Soil Fertility and Sustenance of Agricultural Productivity” (RAS/5/039)**

- **Regional Training Course, 8 – 12 April 2002, Kuala Lumpur, Malaysia**

This training activity was organized by the Agency with support from the Malaysian Institute for Nuclear Technology Research (MINT). Sixteen participants from 10 countries (Bangladesh, China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand and Viet Nam) and three observers from Malaysia attended the Training Course. The Course Director was Dr. Khairuddin Abdul Rahim (MINT). The Technical Officer, Mr. Gamini Keerthsinghe, conducted the training with the support of Dr. Ian Fillery (CSIRO Plant Industry, Perth, Australia) and Prof. Zaharah Abdul Rahman (Faculty of Agriculture, Universiti Putra Malaysia, Selangor). The main aim of the course was to provide training on the use of ^{15}N techniques for identifying efficient nitrogen fertilizer management practices to the local staff directly involved in the implementation of laboratory and field investigations of the project. The following main topics were covered: General introduction to stable and radioactive isotopes and their use in agricultural research; nitrogen transformations in wetland rice soils and fertilizer management practices to optimise nitrogen use efficiency; use of ^{15}N in laboratory and field investigations to follow the fate of applied nitrogen fertilizers; soil and plant sampling techniques for ^{15}N analyses; sample preparation and methods for ^{15}N analyses; interpretation of results.

⇒ **FAO/IAEA TCP on “Biofertilizers for increased legume production” (BGD/5/017)**

This project has been operational since 1995 with the main objective of assisting the country in establishing technologies for pilot-scale production of *Rhizobium* inoculants for grain (pulse) legumes. Tasks and activities have been implemented by the Bangladesh Institute of Nuclear Agriculture (BINA) and the Department of Agricultural Extension (DAE) of the Ministry of Agriculture working in close partnership. The latter was included to create awareness of these technologies among farmers and establish a market for the inoculants through field demonstrations.

- **Project Evaluation Mission, 4 – 14 March 2002, Mymensingh and Dhaka, Bangladesh**

Dr. K. A. Malik, Member (Biosciences), Pakistan Atomic Energy Commission (PAEC), Islamabad, Pakistan, carried out the mission at BINA, Mymensingh and BAEC, Dhaka, Bangladesh. The terms of reference were: 1) To assess current developments on *Rhizobium* inoculant production and quality control and quality assurance and formulate recommendations to overcome problems/limitations already identified in recent workshops (March and August 2001), 2) To evaluate results of back-up research and extension (training and demonstration activities on *Rhizobium* technologies); and 3). To explore the potential of developing other biofertilizer technologies for their inclusion in rice-based cropping system.

The findings of the mission are as follows: i) BINA has the capacity to undertake *Rhizobium* inoculants production on a commercial scale, ii) There is potential to further improve the current *Rhizobium* biofertilizer technologies, and iii) Work on these and other biofertilizer technologies must be related and connected with the integrated approach being pursued in IAEA TC project BGD/5/022 “Integrated Nutrient and Pest Management for Crop Mutants in Rice-based Cropping Systems”.

NON-FAO/IAEA MEETINGS

⇒ **10th Meeting of the Regional Technical Co-ordination Committee (RTCC) of the Rice Wheat Consortium (RWC) of the Indo-Gangetic Plains (IGP), 9 – 15 February 2002, New Delhi, India**

The RWC <http://www.rwc-prism.cgiar.org/rwc/index.asp> was established in 1994 as an Eco-regional Initiative of the Consultative Group on International Agricultural Research (CGIAR), involving the National Agricultural Research Systems of South Asia, the International Agricultural Research Centres and Advanced Research Organizations. Annual meetings are held to review progress in on-farm and on-station experimentation being carried out by NARS into improved agronomic and water management practices.

Mr. P.M. Chalk participated in the 2002 annual meeting and made a presentation in Technical Session 4 (New Initiatives and Special Briefings) on the new FAO/IAEA CRP “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia” (D1.50.07) describing project objectives, modalities and linkages with the RWC. The CRP is designed to complement experiments in India, Nepal, Bangladesh and Pakistan being conducted by the NARS in close collaboration with the IRRI Rice-wheat co-ordinator. The new CRP will also foster closer collaboration and exchange of information between the IGP countries and China who presently has only observer status within the RWC. The CRP will add considerable value to the on-going experiments through collection of data on N fertilizer use efficiency (¹⁵N labelled fertilizer recovery and loss) and agronomic water use efficiency (soil moisture neutron probe) by both wheat and rice, which will enhance decision making on timing, frequency, amount and placement of external inputs. It is planned to hold the 3rd RCM of CRP D1.50.07 in conjunction with the 13th RTCC in Bangladesh (February, 2005).

The new CRP is one of many new initiatives within the RWC involving a variety of donor organizations and national and international research institutes. The exchange of information is being facilitated by a new web-based information system (RWC-PRISM) – Project and Research Information System Module. Information on CRP D1.50.07 will be available on PRISM and also reported in the RWC newsletter (Rice-Wheat Information Sheet, RWIS).

Presentations made by the NARS counterparts of the RWC showed that new water saving technologies (bed planted and furrow-irrigated wheat, laser levelled fields) and conservation agriculture (zero tillage) practices are being rapidly adopted by farmers in the IGP. Local farmer associations are being formed in rice-wheat areas of Uttar Pradesh and elsewhere in India and the IGP countries to debate and disseminate improved farming practices. The RWC has played a crucial role in fostering the adoption of the new technologies through provision of demonstration equipment (laser levellers, bed formers/planters, mobile press for producing urea super-granules, leaf colour charts) and through on-farm participatory trials co-ordinated by the NARS and funded by the Asia Development Bank. The private sector has also played a key role in improving the design of agricultural machinery used to form and plant on beds and deliver fertilizer.

Nevertheless, there is an urgent need for irrigation scheduling to be placed on a rational basis, and government policies are not yet in place to encourage the conservation of the ever-decreasing reserves of surface and ground waters. Indeed, shortage of water will undoubtedly become the most critical issue facing agriculture during the present decade. There is also an increasing awareness that crop diversification in intensive rice-wheat systems in the IGP is highly desirable, due to the foreshadowed oversupply of cereal grains and the present need to import pulses and other crops. Short duration, drought-tolerant and disease-resistant legume cultivars are urgently needed to fill niches in the intensive cropping system. In addition, new and innovative agronomic approaches to synchronize crop sequences are required to enable optimal utilization of the available resources and fulfill demand for specified agricultural products.

⇒ **2nd Phaseomics Conference – Beans (*Phaseolus* spp.) – Model Food Legumes, 16 – 19 May, Geneva, Switzerland**

Approximately 50 participants from all regions as well as local scientists attended the meeting, which was organized by Professor W.J. Broughton, University of Geneva. Mr. Gudni Hardarson, SSU Seibersdorf, gave a presentation entitled “Use of ¹⁵N to Quantify Biological Nitrogen Fixation in Common Beans”, chaired a session on “Biological Nitrogen Fixation in Common Beans” and participated in the development of a project proposal on common beans to be submitted to the EU for funding.

The objective of the “Phaseomic” programme is to develop/utilize tools/methodologies for improving (crossing and breeding) domesticated *Phaseolus* species in order to assure sustainable production of highly nutritious high protein crops for human consumption. Further information on the Phaseomics programme can be obtained at www.Phaseolus.org

E. STATUS OF CO-ORDINATED RESEARCH PROJECTS

⇒ **Use of Isotope Techniques in Studies on the Management of Organic Matter and Nutrient Turnover for Increased, Sustainable Agricultural Production and Environmental Preservation**

Project Officer: G. Keerthisinghe

The implementation of this CRP was completed in 2001. All contract holders have submitted manuscripts for inclusion in an IAEA-TECDOC. The project officer will collate the manuscripts and prepare the TECDOC, which will include the major achievements and conclusions of the project. Some contract holders have already published their results in scientific journals.

⇒ **The Use of Nuclear and Related Techniques in the Management of Nutrients and Water in Rainfed Arid and Semi-arid Areas for Increasing Crop Production**

Project Officers: G. Keerthisinghe and L. Heng

The third and the final RCM of this CRP was held in Vienna, 24 - 28 September 2001, at which the overall progress and significant achievements of the project were reviewed and discussed. All contract holders were requested to present their final reports before the end of June 2002. All data submitted will be evaluated using crop simulation models such as APSIM and Ms. Lee Heng is co-ordinating this activity. The deadline for the submission of manuscripts for inclusion in an IAEA TECDOC is 31 December 2002. The project officers will collate the manuscripts and prepare the TECDOC, which will include the major achievements and conclusions of the project. Participants are also encouraged to prepare manuscripts for publications in scientific journals.

⇒ **Use of Nuclear and Related Techniques for Evaluating the Agronomic Effectiveness of P Fertilizers, in Particular Rock Phosphates**

Project Officer: F. Zapata

Several outputs have been obtained from this project. The IAEA TECDOC 1272 “Assessment of soil phosphorus status and management of phosphatic fertilizers to optimise crop production” was published as hard copy and CD versions in February/March 2002, respectively. The peer review of 11 manuscripts submitted for the production of a special issue of the journal *Nutrient Cycling in Agro-ecosystems* has been completed and its publication is expected during 2002. The production of a FAO Land and Water Technical Bulletin on “Use of Local Phosphate Rocks in Sustainable Agriculture” as a joint undertaking of two FAO Divisions (AGE/AGL) is being implemented. The first drafts of all chapters are currently under peer review.

In the frame of an MOU between the Joint FAO/IAEA Division and the International Fertilizer Development Center (IFDC) concerning collaboration in soil, water and nutrient management research, both organizations have decided to join efforts in the development of a Decision Support System for direct application of phosphate rocks (PR-DSS) during the 2002-2003 biennium. The PR-DSS will be a useful research and extension tool for scientists,

extension workers, progressive farmers, planners and agribusiness dealers, thus contributing to promote the use of phosphate rock resources in tropical and sub-tropical Member States. The IAEA has awarded a technical contract to IFDC to develop a customized database on phosphate rocks. The Government of the Netherlands has confirmed its approval to contract a Junior Professional Officer to serve as an assistant on this project in IFDC at Muscle Shoals, USA. Under the Joint FAO/IAEA Division IT pilot project, a web-based decision support system on phosphate rock will be developed. This will allow instant on-line generation of simulated results, retrieval and upload of data and information relating to PR use. Provisions have also been made in the IAEA programme of work and budget 2004-2005 for this work and the field validation of the PR-DSS.

⇒ **Assessment of Soil Erosion Through the Use of Caesium-137 and Related Techniques as a Basis for Soil Conservation, Sustainable Production and Environmental Protection**

Project Officer: F. Zapata

Implementation of this project was completed in 2001. The final report of the CRP is available upon request from the Project Officer. Several follow-up activities are now underway. Good progress has been made in the production of a special issue of the journal *Soil and Tillage Research*. Peer review of the manuscripts will be completed soon, with 50% of the papers already accepted for publication.

Significant progress was also made in the production of a handbook “Soil Erosion and Sedimentation Research using Environmental Radionuclides”. The draft versions of nine chapters were collated and edited. Currently, the authors have completed the revision of their contributions. The IAEA Publications Committee has approved the external publication by Kluwer Academic Publishers. The final step will be editing in a “camera ready” format for printing.

⇒ **Use of Nuclear Techniques for Developing Integrated Nutrient and Water Management Practices for Agroforestry Systems**

Project Officer: G. Keerthisinghe

Participating in this CRP are nine contract holders: K. Aihou (Benin), B. Zhang (China), C. Ovalle Molina (Chile), C. Cervantes (Costa Rica), J.M. Ndufa (Kenya), Z. Rahman (Malaysia), S. Nissanka (Sri Lanka), P. Ebanyat (Uganda) and R. Chintu (Zambia); and five agreement holders: M. Adams (Australia), S. Recous (France), L. Verchot (ICRAF-Kenya), N. Sanginga (IITA-Nigeria) and M. Smith (UK). All contract holders have on-station and on-farm experiments under way and the results presented at the second RCM showed that the experimental work is progressing according to the work plan and experimental guidelines established at the first RCM. The project has maintained the flexibility necessary to address location specific needs and tree species well-adapted to local conditions have been selected for the experiments and have been integrated into existing cropping systems. Isotope techniques are being used to quantify nutrient and water dynamics in agroforestry systems in order to modify management practices for better resource utilization. Linkages with CG centres and other agroforestry projects have been established for effective implementation of project activities. The third RCM of the project will be held in June 2003.

⇒ **Development of Management Practices for Sustainable Crop Production Systems on Tropical Acid Soils through the Use of Nuclear and Related Techniques**
Project Officer: F. Zapata

This CRP started implementation at the end of 1999 and the first RCM was held in Vienna in June 2000. Eight research contract holders: P. Houngnandan (Benin), S. Urquiaga (Brazil), T. Muraoka (Brazil), V. Bado (Burkina Faso), A. García (Cuba), J.J. Peña-Cabriales (Mexico), E. Iwuafor (Nigeria), and M. Lopez (Venezuela); one technical contract holder: P. Randall (Australia), and four agreement holders: W. Horst (Germany), S.H. Chien (IFDC-USA), B. Vanlauwe (TSBF-Kenya), and J. Diels (IITA-Nigeria) are currently participating in the project. The second RCM was held recently in March 2002 in Brasilia, Brazil (refer to past events). Research work on the best adapted genotypes is considered strategic and it will be continued by selected participants and the support of a technical contract to evaluate the effect of the inclusion of the P-efficient genotypes into the overall P-efficiency of the studied cropping systems. Similarly, field studies on crop rotations (cereal-legume) will continue but with a more integrated approach to SWNM in selected agro-ecological zones of the savannas of Africa and Latin America. Revised guidelines and research protocols have been produced. They reflect the progress made in the project through a better understanding of the constraints to agricultural productivity and the prioritisation of the studies to be undertaken for further implementing the project. A detailed evaluation of the studies conducted by the participants has been made and a mid-term review report is in preparation.

⇒ **Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia**
Project Officer: P. Chalk

This CRP was approved in February 2001 and the project commenced on 1 October 2001, with an anticipated duration of 5 years. The overall objective is to improve the productivity and sustainability of rice-wheat cropping systems through increased efficiency of water and nutrient use. The specific research objective is to modify existing water and nutrient management systems, and improve soil management in both traditional and emerging (raised beds, non-puddled soil, direct seeding) tillage systems, for sustainable intensification of cereal production. Six research contracts were awarded: Md. Murshedul Alam (Bangladesh), Qirong Shen (China), Jiarong Pan (China), Yadvinder Singh (India), Raj Shrestha (Nepal) and Fayyaz Hussain (Pakistan). Another research contract (Manbir Sachdev, India), will become operational on 1st August 2002. There are presently three agreement holders: Elizabeth Humphreys (CSIRO-Australia), J.K. Ladha (IRRI-Philippines) and Raj Gupta (CIMMYT-India). The first RCM and training workshop was held 4 – 8 March 2002, in Vienna and Seibersdorf, Austria (see Past Events). The second RCM is planned for 22 – 26 September 2003, in Nanjing, China, with Prof. Q. Shen, Nanjing Agricultural University, as the local organiser.

⇒ **Assess the effectiveness of soil conservation techniques for sustainable watershed management using fallout radionuclides**
Project Officer: F. Zapata

This CRP was approved in March 2002 and implementation will start in 2003 with an anticipated duration of 5 years. The project was advertised in the December 2001 issue of the

Soils Newsletter with a call for applications for research contracts and agreements (deadline 30 August 2002). The overall objective is to develop improved land use and management strategies for sustainable crop production through effective soil erosion control practices. The specific research objectives are: i) to further develop fallout radionuclide methodologies, with particular emphasis on the combined use of ^{137}Cs , ^{210}Pb and ^7Be for measuring soil erosion over several spatial and time scales, ii) to establish standardized protocols for the combined application of the above techniques, and iii) to utilise these techniques to assess the impact of short-term changes in land use practices and the effectiveness of specific soil conservation measures. The first RCM and training workshop will be held in the first quarter of 2003, in Vienna and Seibersdorf, Austria.

F. NEW FAO/IAEA CO-ORDINATED RESEARCH PROJECT

1. **Title:** Selection for greater agronomic water-use efficiency in wheat and rice using carbon isotope discrimination
2. **Proposed duration:** 5 years (2003-2007)
3. **Introduction:**

For established wheat and rice breeding programs, yield plateaux are being approached for both favourable and water-limited environments. The understanding of physiological traits that contribute to yield has improved in recent years. This has opened up new opportunities to improve the rate of genetic increase in yield. Genetic increases in crop yields in dry and saline areas have not been as great as in more favourable environments or where irrigation is available. A likely reason for this is that dry environments are characterized by unpredictable and highly variable seasonal rainfall, and hence highly variable yields. Similarly, saline environments show large spatial and temporal variability in the degree of salinization. For both droughted and saline environments, the high environmental variability results in slow genetic advances in breeding programs because genetic variation for yield is masked by large genotype x year and/or genotype x location interactions. Even though yield increase has been greater in favourable environments, progress is not keeping up with demand. New techniques need to be applied to accelerate progress.

Carbon isotope discrimination has been shown to have substantial potential application as a screening tool in breeding programs to increase the rate of genetic increase in yield. The isotopic ratio of ^{13}C to ^{12}C in plant tissue is less than the isotopic ratio of ^{13}C to ^{12}C in atmospheric CO_2 , indicating that plants discriminate against ^{13}C during photosynthesis, particularly C-3 plants such as wheat, peanuts and cotton in which the primary carbon dioxide acceptor is ribulose bi-phosphate (RuBP). Variation in discrimination against ^{13}C during photosynthesis is due to both stomatal limitations and enzymatic processes. When photosynthesis occurs under conditions of salinity or water stress, the ratio of ^{13}C to ^{12}C is altered in the plant tissue because of a slower diffusion of heavy carbon dioxide through plant stomata and preferential fractionation for ^{12}C over ^{13}C during enzymatic carboxylation reactions of photosynthesis. Numerous studies have shown carbon isotope discrimination provides an integrated measure of water use efficiency and salt tolerance of plants. Thus, this method has conceptual and practical advantages over measuring water use efficiency or salt

tolerance by instantaneous measurements of gas exchange or destructive sampling as whole plant harvests. Since the plant samples (e.g. leaves) can be easily collected for analyses, the method enables analysis of a large number of samples from diverse environments. Preliminary studies conducted at the Soil Science Unit, Seibersdorf, showed that leaf disks collected with a hole puncher can be used for determination of carbon isotope discrimination of different wheat cultivars subjected to salinity stress. Results showed that carbon isotope discrimination decreased significantly and linearly with increasing salinity in wheat cultivars, demonstrating the potential of this technique as a tool for screening plants for salt tolerance.

A breakthrough program in Australia, breeding for low carbon isotope discrimination in wheat, has developed a new variety with increased yield under stored-soil moisture conditions. However, it is not known how universal this outcome would be. For example, in other environments, positive associations between yield and carbon isotope discrimination have been observed, and these associations have not been tested for their application in breeding programmes.

Important questions remain to be answered. Do breeders select for high or low carbon isotope discrimination in specific types of environments? Are the associations influenced by genetic background? What are the most efficient breeding methods to use? What part of the plant should be used for measuring carbon isotope discrimination? Can the technique be applied to improve production in drought or saline environments?

IAEA has long-standing experience in developing and co-ordinating collaborative research programs involving NARS in developing countries, IARCs and scientists from developed countries. The FAO/IAEA Agriculture and Biotechnology Laboratory, Seibersdorf also has the experience and facilities for making the numerous, precise measurements of carbon isotope discrimination in plants critical for the successful implementation of this CRP.

4. OBJECTIVES

4.1. Overall Objective

To contribute to increasing the agronomic water-use efficiency (AWUE) of wheat and rice production where AWUE is defined as grain yield/total water use including both transpiration and evaporation.

4.2. Specific Objectives

4.2.1. To evaluate different strategies for using carbon isotope discrimination as a selection tool for identifying higher yielding genotypes of (a) wheat in water-limited rain-fed stored soil moisture cropping systems, (b) wheat in irrigated cropping systems and (c) rice in irrigated cropping systems.

4.2.2. Within 4.2.1. to develop sets of elite isomorphic lines varying in carbon isotope discrimination for use in 4.2.3.

4.2.3. Using a set of these isomorphic breeding lines evaluated in contrasting cropping environments, assist national program scientists to determine the most effective breeding strategies for application of carbon isotope discrimination in their environments.

5. EXPECTED OUTPUTS

- 5.1 (a) Effectiveness of back-cross Low carbon isotope discrimination selection strategy determined for wheat in stored soil moisture condition.
(b) Effectiveness of Low vs High carbon isotope discrimination selection strategies determined for wheat in irrigated environments.
(c) Effectiveness of Low vs. High carbon isotope discrimination selection strategies determined for rice in irrigated non-saline & saline environments.
- 5.2 (a) Sets of elite isomorphic lines varying in carbon isotope discrimination for both wheat & rice that can be used to evaluate selection strategies.
(b) Individual wheat & rice lines that are developed may be useful as cultivars or parents in national breeding programmes.
- 5.3 For wheat, effective selection strategies using carbon isotope discrimination would be developed for specific mega environments.

6. WORK PLAN

6.1. Tasks:

6.1.1. In relation to specific objective 4.2.1.(a):

- Select a contract holder with an established wheat-breeding program, in a water-limited stored soil moisture environment. The contract holder would preferably be collaborating with CSIRO to identify a suitable recurrent parent & a low-delta donor.
- To conduct a back-crossing programme including selection for Low leaf carbon isotope discrimination at intermediate generations to generate stable lines.
- Evaluate selected lines for yield & carbon isotope discrimination (leaf & grain) in water-limited stored soil moisture target production zone.

In relation to specific objective 4.2.1.(b):

- Select existing CIMMYT and CSIRO project wheat breeding lines for High & Low leaf carbon isotope discrimination.
- Evaluate selected lines for yield and carbon isotope discrimination under high yield potential irrigated conditions.

In relation to specific objective 4.2.1.(c):

- Select a contract holder with an established paddy rice-breeding programme.
- IRRI and NARS to identify suitable elite rice parents for Low x High and High x High carbon isotope discrimination crosses.
- Select for High & Low carbon isotope discrimination.
- Evaluate selected stable lines for yield and carbon isotope discrimination under non-saline and saline irrigated conditions.

In relation to specific objective 4.2.2.:

- Using the 3 selection programs described in 4.2.1. produce sets of elite isomorphic stable lines varying in carbon isotope discrimination, for both wheat and rice.

In relation to specific objective 4.2.3:

- Under a CIMMYT-type international varietal testing program, NARS would evaluate CSIRO sets of elite isomorphic lines varying in carbon isotope discrimination, and their local check varieties, in wheat mega environments. Grain yield and grain carbon isotope discrimination and in some cases leaf carbon isotope discrimination will be determined and the current environment would be characterized. Agreement holders would interact with national program colleagues to evaluate the complete set of data.
- When they become available, the additional set of elite isomorphic lines of carbon isotope discrimination described in 4.2.2. would be evaluated in a similar manner under CIMMYT and IRRI-type international varietal testing programs.

6.2. Sites & Partners Selection

6.2.1. Agreement holders:

- Commonwealth Scientific and Industrial Research Organization (CSIRO)
- International Maize and Wheat Improvement Center (CIMMYT - Centro Internacional de Mejoramiento de Maiz y Trigo)
- International Rice Research Institute (IRRI)

6.2.2. Contract holders:

For multi-location testing

- Established breeding programs in wheat & rice.

For conducting crossing & selection programs

- An established wheat-breeding program in a water-limited stored soil moisture environment.
- An established paddy rice-breeding program in a high yield potential environment.

6.2.3. Locations:

Multi-location testing sites would be selected in consultation with CIMMYT for wheat and IRRI for rice.

For wheat, environments would include:

- Favourable, irrigated, low rainfall (CIMMYT ME1).
- Winter-rainfall or Mediterranean-type with post-flowering stress (CIMMYT ME4A).
- Winter drought with pre-flowering moisture stress (CIMMYT ME4B).
- Receding, stored soil moisture (CIMMYT ME4C).

For rice, environments would include:

- Non-saline paddy systems.
- Saline paddy systems.

7. Call for Proposals

Proposal forms for research contracts and agreements can be obtained from the web at <http://www.iaea.org/programmes/ri/uc.html>. They must be countersigned by the Director of the Institution and submitted to the Head, Research Contracts Administration Section, IAEA, Vienna. Please note that **they should be received before the deadline of 31 March 2003**. Further information can be obtained from the Project Officer, Mr. Gamini Keerthisinghe at G.Keerthisinghe@iaea.org

G. LABORATORY ACTIVITIES

TRAINING

Training is provided by the Soil Science Unit (SSU) of the FAO/IAEA Agriculture and Biotechnology Laboratory in the form of training courses or workshops, fellowships or scientific visits. The subject of training is predominantly the use of nuclear technology in soil science, soil and water management, crop nutrition and isotope analyses.

⇒ Fellowships

The SSU trains approximately 10 – 15 fellows annually. The training periods vary from 2 to 10 months. There are two categories of fellows, i.e. *Analytical fellows*, who are accepted for short periods of 2 to 3 month to learn isotope analytical techniques used in plant nutrition. This form of training includes technical tutoring and hands-on practical sessions. Particular emphasis is given to specific techniques relevant to research conducted under technical co-operation projects, i.e. total N and ^{15}N isotope-ratio analyses by emission spectrometry. Whenever possible, group training of three to five fellows is organized every year. *Research fellows* are accepted for periods between four and ten months to work on problems or techniques related to the Unit's research programme. The fellows receive guidance on experimental strategies and the use of isotopes and related techniques relevant to a particular area of research, which the fellow will pursue upon return to his or her home country. The fellow is expected to complete and write up a report of the research conducted.

- **Group Training, 15 October – 7 December 2001, SSU Seibersdorf**

Group training on total N and ^{15}N analyses by optical emission spectrometry included sessions on: Introduction to ^{15}N isotope techniques using mass and emission spectrometry (one week); sample preparation of plant and soil material using Kjeldahl digestion (two weeks); NOI-6/NOI-7 emission spectrometer calibration and measurement of samples prepared during the previous session (three weeks); maintenance, small repairs and troubleshooting of the NOI-6/NOI-7 instruments with co-operation from the Instrumentation Unit (one week); quality assurance of total N and ^{15}N analysis and staff consultation (one week).

The following fellows participated in the activity:

Ms. Angella Nansamba, UGA/01013P;
Ms. Mamura Kadyrkhodjaeva, UZB/01026P;
Mr. Hakan Kislal, TUR/00002P;
Mr. Charles Makalanga, URT/01012R and
Mr. Godfrey Kaunye, ZIM/00004R.

In addition, **Ms. Agnieszka Rutkowska** from Poland, participated as a cost-free intern from 5 – 30 November in the emission spectrometer sessions and **Mr. Moustapha Smailou**, NER/01001R, participated from 1 – 9 October in the instrumentation training session, which concentrated on troubleshooting for the NOI-6 spectrometer.

- **Research Fellows, January – June 2002, SSU Seibersdorf**

Mr. Mohammad Alfaz Atawoo from Mauritius (MAR/01003P) is undergoing training on the use of ^{15}N techniques for studying the fate of fertilizer nitrogen and balance in soil-plant systems. He has set up a greenhouse experiment to measure the uptake and use efficiency of different levels of urea-N, with and without added poultry manure, applied to wheat. He is being trained to sample the soil solution using porous cups for nitrate measurements. He is also associated with the on-going field experiment with wheat under flat-bed and raised-bed planting for measurement of water flux using tensiometers and the neutron moisture probe. Supervised by Mr. Manbir Sachdev.

Ms. E.W. Temu, from Tanzania (URT/01057R) is receiving training on the use of ^{15}N to quantify biological nitrogen fixation, and microbiological methods to study rhizobial strains and their nodulation of leguminous crops. She has set up greenhouse experiments with the ^{15}N isotope dilution method and is participating in the work of the Unit on below-ground nitrogen in leguminous crops. Supervised by Mr. Gudni Hardarson.

Ms. N. Mikhailouskaya from Belarus (BYE/01009P) attended a one-month introduction to the use of ^{15}N to quantify biological nitrogen fixation. Supervised by Mr. Gudni Hardarson.

Mr. C. Ratnayake from Sri Lanka (SRL/02004P) is receiving training in soil physics and water use efficiency. Supervised by Ms. Lee Heng.

Mr. M Al-Chammaa from Syria (SYR/01024R) received training on mass spectrometry and routine analyses of enriched isotope samples. Supervised by Mr. Leo Mayr.

⇒ **Scientific Visits**

The SSU receives Agency-sponsored scientific visits, each for approximately one or two weeks. The purpose is for the visitors to get acquainted with recent developments in the use and application of specific nuclear techniques in soil science and plant nutrition. There is also an opportunity for scientists to get on-the-job training as cost-free interns. Recent scientific visitors to the SSU were:

Mr. M.S. Rahman, Bangladesh

Mr. A. K. S. Gopaul, Mauritius

⇒ **Training Workshops**

- **Training workshop on “The Use of Isotopes and Radiation Techniques to Study Soil and Water Management and Crop Nutrition”, 7 – 8 March 2002, SSU Seibersdorf**

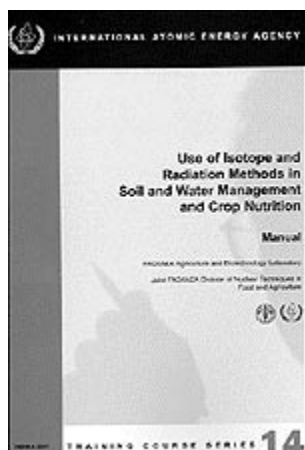
This workshop was held for participants in the 1st RCM of the CRP on “Integrated Soil, Water and Nutrient Management for Sustainable Rice-Wheat Cropping Systems in Asia”.

- **Training workshop on “The Use of Nuclear Techniques in Soil, Water and Nutrient Management in Rainfed Arid and Semi-arid Areas” 19 – 21 March 2002, SSU Seibersdorf**

This workshop was held for participants in the regional TCP for Africa on “Combating Desertification in the Sahel” (RAF/5/048) and for the research fellows being trained at the Unit.

⇒ **Training Manual**

Effective fellowship training requires good reference materials in the form of manuals or guidelines for hands-on practical experience with nuclear techniques. To meet this need Training Course Series No. 2 “Use of Nuclear Techniques in Studies of Soil-Plant Relationships” was produced in 1990 and more than two thousand copies were distributed to Member States. Drs. Rebecca Hood-Nowotny and Graeme Blair, visiting scientist to the SSU, have completely revised and edited this manual. It is available free of charge upon request. Comments and suggestions for further improvements are welcome.



- **Use of Isotope and Radiation Methods in Soil and Water Management and Crop Nutrition. Manual. Training Course Series No.14, 247 p. IAEA, Vienna (2001).**

Summary

Chapter 1 provides an overview of the theory and use of stable and radioactive isotopes in soil science and plant nutrition including definitions and principles of measurement.

Chapter 2 comprises the major part of the manual with 11 Sections dealing with applications of nuclear techniques in soil fertility and plant nutrition, including the use of isotopically labelled fertilizers to estimate fertilizer recovery by crops, residual amounts in soil and losses by either mass balance or direct measurement. Applications of both stable (^{15}N) and radioactive (^{32}P , ^{33}P) isotopes are described with worked examples and exercises using published data. New Sections document advances in the study of the cycling of carbon and sulphur in the soil-plant-animal-atmosphere system, including the use of stable isotopes (^{13}C , ^{34}S) to replace radioactively labelled materials (^{14}C , ^{35}S). Natural abundance ($\delta^{13}\text{C}$) techniques to estimate turnover rates of soil organic matter and to identify plant genotypes with high water use efficiency are both described. Techniques to label plant material with either one or two isotopes permit the simultaneous estimation of the fate of several organically bound elements (e.g., C, N, S) during the decomposition of plant residues or manures. The use of indirect or isotope (reverse) dilution techniques (e.g., ^{15}N , ^{35}S) as an alternative to direct labelling of fertilizers or plant residues are also described. Similarly, ^{15}N dilution methods for estimating biological nitrogen fixation by legumes are outlined. The Chapter is completed with Sections on the soil moisture neutron probe and experimental design and statistical analysis.

Chapter 3, *A Practical Guide to Using Nuclear Techniques in the Laboratory, Glasshouse and Field*, incorporates and expands upon material included in previous editions. It covers general laboratory practice and the requirements for radiation installations. Procedures for the preparation of radioactive labelled fertilizers and plant and soil samples for chemical analyses are described. The final two Sections describe the design of pot and field experiments using stable isotopes.

Chapter 4, *Laboratory Methods*, brings together in a coherent manner analytical procedures that are commonly used to characterize soil and plant materials in terms of elemental and isotopic composition, drawing on the extensive experience of the Soil Science Unit, Seibersdorf.

Chapter 5, *Quality Assurance*, is a valuable addition to the manual as it describes the production of labelled plant internal reference material, basic requirements of analytical laboratories, quality control procedures and assessment of performance.

Chapter 6, *Modelling*, provides basic information on goals, strengths and weaknesses, classification, processes, data requirements and the use of models in decision-making. It is a timely addition to the manual as modelling has provided a valuable tool in integrating results

obtained in multinational research networks covering a range of climatic conditions, soils and cropping practices.

SUPPORTIVE SERVICES AND QUALITY ASSURANCE

⇒ **Isotope Analyses**

Co-ordination: L. Mayr

- **1 January – 31 December 2001**

Number of samples received:

CRP	4,798	51.8%
TC	644	6.9%
Seibersdorf	3,829	41.3%
Total	9,271	100.0%

Number of measurements carried out:

	¹⁵ N	¹³ C	¹⁸ O	Sum
Reported results	9,031	3,050	129	12,210
Analysis overhead (calibration, blank, QA-std, reps, test)	4,976	1,751	230	6,957
Total	14,007	4,801	359	19,167

- **1 January – 30 April 2002**

Number of samples received:

CRP	1,565	82.1%
TC	172	9.0%
Seibersdorf	170	8.9%
Total	1,907	100.0%

Number of measurements carried out:

	¹⁵ N	¹³ C	¹⁸ O	Sum
Reported results	1,462	1,087	0	2,549
Analysis overhead (calibration, blank, QA-std, reps, test)	1,905	570	0	2,475
Total	3,367	1,657	0	5,024

⇒ **External Quality Assurance. Annual proficiency testing exercise on total N and ¹⁵N abundance in plant materials (EQA 2000 vs. EQA 2001)**

Co-ordination: M. Aigner

As reported in the previous Newsletter, twenty-seven ¹⁵N analytical laboratories from Member States in five regions expressed their interest to participate in EQA 2001 and received the test panel. Nineteen laboratories submitted a full set of results in time. Very good results were received from institutes in Argentina (CNEA), Belgium, Chile, Cuba, Ivory Coast, Syria, Thailand, Turkey, Uzbekistan and Venezuela. Satisfactory results were received from institutes in Argentina (LANAIS), China, Mexico and Viet Nam. Other participants provided data not fully complying with the control limits established by the Soil Science Unit.

The total number of laboratories producing very good or satisfactory results was similar in 2000 and 2001 (14 and 15, respectively) with a consistent performance in Europe and Latin America. However, the distribution across two regions differed between years, with fewer laboratories in Africa performing at an acceptable level but slightly more laboratories in Asia complying with the Agency's standards.

Year 2000	Number of participating laboratories	Number of laboratories producing very good or satisfactory results
Africa	8	4
Asia	10	3
Europe	2	2
Latin America	9	6
Total	29	15

Year 2001	Number of participating laboratories	Number of laboratories producing very good or satisfactory results
Africa	8	1
Asia	8	5
Europe	3	2
Latin America	8	6
Total	27	14

H. PUBLICATIONS

⇒ Printed

- Use of Isotope and Radiation Methods in Soil and Water Management and Crop Nutrition. Manual. IAEA-TCS-14, 247 p. (December 2001).
- Water Balance and Fertigation for Crop Improvement in West Asia. Results of a FAO/IAEA Technical Co-operation Project. IAEA-TECDOC-1266, 117p. (January 2002)
- Assessment of Soil Phosphorus Status and Management of Phosphatic Fertilizers to Optimise Crop Production. Results of a FAO/IAEA Co-ordinated Research Project. IAEA-TECDOC-1272, 473 p. (February 2002) and IAEA-TECDOC-1272CD (March 2002).
- Nuclear Techniques in Integrated Plant Nutrient, Water and Soil Management. Proceedings of an International Symposium, 16 – 20 October 2000, Vienna, Austria. IAEA-C&S-11 and IAEA-C&S-11/C, 494 p. (June 2002).
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